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1 SEM TDC ECOH (CBCS) C 2

2021

(Held in January/February, 2022)

ECONOMICS

(Core)

Paper : C–2

(Mathematical Methods for Economics—I)

Full Marks : 80

Pass Marks : 32

Time : 3 hours

The figures in the margin indicate full marks for the questions

1. Choose the correct option : 1×8=8

(a) $A \cup A' = ?$

(i) U

(ii) A

(iii) A'

(iv) ϕ

(b) The set of prime numbers is

(i) {10, 12, 20}

(ii) {2, 3, 5}

(iii) {4, 6, 8}

(iv) None of the above

(c) If $n = 3$, the polynomial function

$$f(x) = a_0 + a_1x + a_2x^2 + a_3x^3 + \cdots + a_nx^n$$

will be known as

(i) constant function

(ii) linear function

(iii) quadratic function

(iv) cubic function

(d) If we take the derivative of total output with respect to labour, we will get

(i) marginal cost

(ii) investment

(iii) marginal revenue

(iv) marginal productivity of labour

(Continued)

(e) $\frac{d}{dx}(5e^{3x}) = ?$

(i) $3e^{3x}$

(ii) $5e^{3x}$

(iii) $15e^{3x}$

(iv) $15e^{x}$

(f) Which of the following is equal to $\int_a^b f(x)dx$?

(i) $\int f(x)dx$

(ii) $-\int_b^a f(x)dx$

(iii) $\int_b^a f(x)dx$

(iv) $e\int_a^b f(x)dx$

(Turn Over)

(g) The correct answer for

$$\int\left(5x+\frac{2}{x}\right)dx$$

is

(i) $\frac{5}{2}x^2+\log x+c$

(ii) $\frac{5}{2}x^2+2\log x+c$

(iii) $\frac{5}{2}x^2+2\log x$

(iv) $x+2\log x+c$

(h) The correct relationship between AR, MR and elasticity is

(i) $|e_d|=\frac{MR}{AR-MR}$

(ii) $|e_d|=\frac{AR}{AR-MR}$

(iii) $|e_d|=\frac{MR}{MR-AR}$

(iv) $|e_d|=\frac{AR}{MR-AR}$

(Continued)

2. Answer any *four* of the following : 4×4=16

(a) Define the following with example :

Null set, Finite set, Equal set, Power set

(b) Evaluate the limit of the following function :

$$\lim_{x\to 5}\frac{x^2-2x-15}{x-5}$$

(c) Explain the relationship between average cost (AC) and marginal cost (MC) using product rule of differentiation.

(d) Calculate the value of

$$\int\frac{4x^3+2}{(4x^4+8x)^5}dx$$

(e) Write a standard first-order linear differential equation with constant coefficient and constant term. What is a homogeneous linear differential equation? Give example.

(Turn Over)

3. *(a)* *(i)* Given $A = \{4, 5, 6\}$, $B = \{3, 4, 6, 7\}$ and $C = \{2, 3, 6\}$. Verify the distributive law of set operations. 3

(ii) The identity cards of 115 people were examined. Some of them were producing voter ID, some of had passport and some people were having both of them. If 65 people were having passports and 30 people had both, how many people have had voter ID only? 4

(iii) If $A = \{2,3,4,5\}$ and $B = \{a,e,i,o,u\}$, then find $A \times B$ and $B \times A$. 4

Or

(b) *(i)* What are whole numbers and rational numbers? Give example. 4

(ii) If

$$A = \{1,3,5\},\ B = \{2,4,6,8\},\ C = \{2,5,10\},$$

$$U = \{1, 2, 3, 4, 5, 6, 7, 8, 9, 10\}$$

then verify that $(A \cap B)' = A' \cup B'$. 4

(iii) In case of ordered pair $(a,b) \neq (b,a)$ unless $a = b$. Explain. 3

4. *(a)* *(i)* Draw the graph of the following function : 3

$$Y = |X|$$

(ii) Determine whether the following function is continuous or not at $x = 2$: 4

$$f(x) = x^2 - 4x + 3$$

(iii) The total cost (C) of a firm per day is a function of its daily output (Q) and it is given by $C = 150 + 6Q$. The firm has a capacity limit of 100 units of output per day. What are the domain and range of the cost function? 4

Or

(b) *(i)* Write short notes on 'rational function' and 'exponential function'. 4

(ii) Find the sum of the cubes of the first 9 natural numbers using the appropriate model. 3

(iii) Formulate the appropriate rule, under which the following sequence run : 4

$$\{1, 6, 15, 28, 45, \cdots\}$$

5. *(a)* *(i)* Find the derivative of the following function : 3

$$y = \frac{2}{x^2} + 5x^3 - \frac{1}{2}x^2$$

(ii) Calculate elasticity of demand of the following function when price $(P) = 10$:

$$D = 720 - 6{\cdot}5\,P$$

Here, D is quantity demanded. Also, comment on the nature of the commodity from the calculated elasticity of demand. 4

(iii) The total cost (TC) function of a firm is given by

$$TC = 200Q - 5Q^2 + 0{\cdot}05Q^3$$

where, Q is quantity produced. Find out the output at which marginal cost (MC) is equal to average cost (AC). 4

Or

(b) *(i)* Calculate the marginal cost (MC) from the total cost (TC) function

$$TC = 1000 + 6Q + 0{\cdot}5Q^2$$

where, Q is quantity produced. 3

(Continued)

(ii) Given the consumption function

$$C(Y) = 2000 - \frac{6000}{(5+Y)}$$

Find out the marginal propensity to consume (MPC) and marginal propensity to save (MPS), when $Y = 95$. 4

(iii) A monopolist has the following total revenue (TR) and total cost (TC) functions :

$$TR = 30Q - Q^2$$

$$TC = Q^3 - 15Q^2 + 10Q + 100$$

Calculate the profit maximizing output and the maximum profit. 4

6. *(a)* *(i)* Calculate the following : 2

$$\int_2^6 (2x^2 + x^3)\,dx$$

(ii) Calculate the saving function from the given marginal propensity to save (MPS) function, provided saving is 0 when income (Y) is 100 : 4

$$MPS = 0{\cdot}8 - \frac{1}{10}Y^{-1/2}$$

(Turn Over)

(iii) The marginal revenue (MR) and marginal cost (MC) of a firm are given below. Calculate profit of the firm when output (Q) is 4 units : 5

$$MR = 5 - 4Q - 3Q^2$$
$$MC = 3 + 2Q$$

Or

(b) (i) Obtain the consumer's surplus of the following demand function, if the market price (P) is 8 : 5

$$Q = \sqrt{42 - \frac{3}{4}P}$$

(ii) Calculate the producer's surplus from the given supply function when price (P) is 6 : 6

$$Q = -3 + 2P$$

7. (a) (i) Solve the differential equation

$$\frac{dy}{dx} + 2y = 0$$

with initial condition $y(0) = 5$. 4

(ii) Analyze the following market model for stability : 8

$$Q_d = 10 - 5P$$
$$Q_s = -10 + 5P$$
$$\frac{dP}{dt} = 3(Q_d - Q_s)$$

Or

(b) (i) Solve the differential equation

$$3\frac{dy}{dx} + 6y = 10$$

given $y(0) = 4$. 4

(ii) Given the demand and supply functions

$$Q_d = a - bP + \beta\frac{dP}{dt} \quad (a, b > 0)$$
$$Q_s = -c + dP \, (c, d > 0)$$

Obtain the time path of price P_t, assuming that the rate of change of price over time is directly proportional to excess demand. 8

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